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comment

# *Interactive comment on* "Biomass burning events measured by lidars in EARLINET. Part II. Results and discussions" *by* Mariana Adam et al.

**Anonymous Referee #3**

Received and published: 7 October 2020

Review of ACP-2020-647, Anonymous

The paper by Adam et al. is part of a 2-part set of papers describing EARLINET observations of biomass burning transport to EARLINET sites in Europe. This second paper specifically covers the attribution of smoke events to longe range transport and regional smoke emissions, and provides an analysis of smoke property changes during transport. The attribution is specifically supported through HYSPLIT trajectory analyses and MODIS fire detections.

The subject matter is highly relevant to ACP and the evaluation of smoke transport dynamics is a significant contribution to the field. Arguably, the vertically resolved information on smoke properties after long range transport is one of the most important contributions by EARLINET as a whole. The quality of the EARLINET data set has

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Discussion paper

been the subject of a long list of previous publications and as such is beyond reproach. The validity of the analysis and attribution methods using the trajectory and satellite fire detection algorithms is less obviously appropriate as indicated by my specific comments and questions below. The presentation quality in the form of figures and text is not at the required high level for ACP – specific suggestions for improvements are made below.

Overall, I would suggest that the paper is not acceptable for publication in its current form. However, because of the importance of the subject matter, the authors should be encouraged to resubmit or address all general and detailed comments included below.

General comments:

1) There is no section of text that describes how the analysis in this paper relates to the contents of paper 1. The authors seem to frequently assume that the reader must have read part 1 prior to reading part 2. This is always the challenge with multi-part papers. While it is appropriate to leave technical details to the other paper, it is not appropriate to require the reader to read the first paper before this one. Please add a section that describes the connectivity of the two papers and why they were divided the way they were.

2) Regarding the focus of the paper, there really is none. It is a confusing mix of single event discussions, source-receptor links, and particle property evolution during long range transport. The Abstract and Conclusion sections are accordingly confusing regarding the paper's main motivation.

3) Pertaining to the quality of the analysis, I fundamentally question the notion that a fire affects an airmass, just because the back-trajectory is located within a certain horizontal distance (100km) and time (1hr) of a satellite fire detection. It seems necessary to detect whether (i) the trajectory is low enough in the atmosphere to be affected or (ii) the fire injection height is likely to have reached the trajectory altitude. This could be done on the basis of simple stability arguments from a reanalysis model. Without

such an analysis, the attribution of smoke layers to given fires is highly questionable.

4) Except for stations explicitly mentioned in the text, there is no way to translate the station acronyms into geographic locations. Please eliminate all use of station acronyms, and provide a map and table with station information.

5) A long list of acronyms are not defined upon first use or not at all: LR, CRLR, SCC.

6) Quality of figures and figure captions is low for many figures – there are many instances of text on top of text (e.g., Fig 1, Fig S6), figure titles that are difficult to understand (e.g., in FigS2 - "evo:# times=13,# times with layers and optical properties=13. # total layers=16"), legend text is too small and/or blurry to read at 100% magnification; these occurrences are too frequent to list in detail. Some figures appear to run on for several pages (e.g., Fig S3), have lots of white space, no identification/letters for subplots, etc. Other figures have different aspect ratios for different subplots (e.g., Fig S4) because the number of events are different for the different stations, but that gives the reader the impression that the stations with fewer events are more important than others, because the former are taller. As a matter of fact, the list of required improvements to the figures is so long and the text is so difficult to follow, that I am breaking off the review in section 4.2. The authors should go through a general effort of making figures mode legible and titles, legends and captions more understandable, rather than relying on this version of figures that was clearly intended for QA purposes, first and foremost.

7) Predominantly in the Abstract and Introduction, there is a confusing lack of distinction in language between receptor regions and smoke origin regions. This makes it difficult to understand the primary purpose of the paper at hand. No map is provided that shows the four receptor regions and the 14 stations therein. Specifically, understanding the meaning of the sentence in the abstract "The results are analysed by means of intensive parameters in the following directions: I) long range transport of smoke particles from North America (here, we divided the events into 'pure North America' and 'mixed'-North America and local) smoke groups, and II) analysis of smoke parti-

cles over four geographical regions (SE Europe, NE Europe, Central Europe and SW Europe)." is very difficult. Given the focus on transport, the word "directions" is highly unfortunate. In fact, considering the entire manuscript, this is a rather poor description of the approach. A simpler description would have been that you analyzed the identified smoke occurrences in four European regions and separated the smoke events into source regions based on trajectory analyses (long-range transport from NA, mixed NA, and local).

8) There is significant room for improvement in the use of English grammar. In particular, the use of definite and indefinite articles and the use of proper verb forms needs to be improved throughout the entire manuscript.

Detailed comments:

1) Page 1, line 36: Define what constitutes an "event" .

2) Abstract contains no statistics of the number of analyzed layers at all stations or in the stations grouped into geographic regions. Please add.

3) Page 2, line 24: I am not familiar with the Keywood study, but based on a google search and my own understanding I can attest that an "inverse effect of BB impact on climate" is not commonly used terminology nor that such an impact is well recognized. Please expand.

4) Page 3, line 22: "The identification of the smoke layers was assessed based on the hypothesis of an existing fire within 100 km and ïĆś 1 h from the time and location of the airmass, respectively". Was the altitude of the back-trajectory near the identified location of fires or an estimated Plume Injection Height not considered in the identification of likely smoke layers? (see general comment above).

5) Page 3, line 26: Davies reference is missing.

6) Page 3: "The mean optical properties within the layers were calculated following a few criteria;..." This statement contains no information. Either add the criteria or

remove.

7) Page 3, line 32: Explain why there are often fewer numbers of parameters retrieved than layers detected in Fig S5.

8) Page 4, line 1: Terra/Aqua do not have four observations per day everywhere. Specify latitude range for which this is true or revise statement to properly reflect frequency of observations relevant to this investigation.

9) Page 4, line 4: provide reference for MODIS fire detection.

10) Page 4, line 18: "same graphics as in Section 3" – this is section 3. Do you mean section 3 of the part 1 paper?

11) Page 4, lines 24-31: I do not understand the purpose of describing an event here that was described in detail in part 1. Without figure, this discussion is difficult to follow. Please describe the relevance for bringing this event up here.

12) Page 5, line 6 and Fig 1: I find panels c and d superfluous – they do not add to my understanding, as this info is contained in the map. The locations of Warsaw and Belsk on the map do not look right – the markers are too close to the border with Belarus.

13) Page 5, line 8: is this supposed to say Figs. 1c, d?

14) Page 5, line 16: "As a first remark...". By virtue of placement in the text, this is not a first remark, but it should be. Please move general description to the front of this section.

15) Page 5 and onward: Section 3.1 is a dense and unacceptably difficult to follow enumeration of facts and statistics that are not linked by any common thought or thread.

16) Page 9, line 10: Figure S7, after significant improvement needs to go into the introduction section and frame the entire paper.

17) Figure 3 caption: explain the meaning of the markers with large error bar symbols.

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